

RAPHIDOPTERA AND NEUROPTERA FROM THE HANFORD SITE OF SOUTHCENTRAL WASHINGTON STATE

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Abstract.—Information is presented concerning the species composition and seasonal appearance of Raphidioptera (snakeflies) and Neuroptera (lacewings and antlions) at the Hanford Nuclear Site located in southcentral Washington State. The Hanford Site represents one of the largest undisturbed remnants of a shrub-steppe habitat in the western United States and includes extensive Holocene and Recent sand dunes. A single snakefly [*Raphidia bicolor* Albarda] and 26 species of lacewings and antlions were collected during the period 1994–1997. New distribution records for Washington are: *Eremochrysa tibialis* Banks (Chrysopidae); *Symphorobius arizonicus* Banks (Hemerobiidae); and *Clathroneuria schwarzi* (Currie), *Brachynemurus sackeni* Hagen, *Psammoleon sinuatus* Currie, *Scotoleon nigrilabris* (Hagen), and *S. peregrinus* (Hagen) (Myrmeleontidae).

Key Words.—Insecta, Raphidioptera, Neuroptera, antlion, snakefly, lacewing, Hanford, biodiversity.

Penny et al. (1997) catalogued the Neuroptera, Megaloptera, and Raphidioptera of America north of Mexico. They listed 45 species in 23 genera and 11 families as occurring in Washington. Johnson (1995) reviewed the Columbia River Basin (including portions of Washington, Idaho, Oregon, and Nevada) fauna of Raphidioptera (snakeflies) and Neuroptera (lacewings and antlions) and found it to contain 86 species in 31 genera. The majority of his records are from Idaho, but the examination of collections at the University of Idaho and Washington State University added six species to the known fauna of Washington that are not listed in Penny et al. (1997). They are: *Chrysopa nigricornis* Burmeister, *C. oculata* Say, *Chrysoperla downesi* (Smith), *Eremochrysa* (*Chrysopiella*) *minora* (Banks), *E. (Eremochrysa) punctinervis* (McLachlan) [Chrysopidae], and *Myrmeleon exitialis* Walker [Myrmeleontidae]. Although the number of species thus far recorded is noteworthy, general studies of neuropterans are lacking for the northwestern United States and the number of species eventually found may increase considerably.

Larval habits of Raphidioptera and Neuroptera play important roles in overall distribution patterns within larger geographic areas. Snakefly larvae are terrestrial and are most often found among pieces of loose bark, in litter, and under rocks and debris on the soil surface. Immatures feed principally on other arthropods found in the larval habitat. Adults, which do not appear to disperse far from larval

environs, are also predaceous with similar feeding requirements as found in immatures.

Within the Neuroptera most larvae are predaceous but prey type taken by differing taxa is diverse. Among the Coniopterygidae, Hemerobiidae, and Chrysopidae one encounters primarily foliage inhabiting larvae that feed on sternorrhynchous Homoptera, especially aphids and to a lesser degree scales. Among adults, feeding habits vary widely with the coniopterygids being predaceous, the hemerobiids being predaceous but also taking pollen and nectar, and the chrysopids with taxa that share feeding strategies with the brown lacewings or feed on pollen or honeydew and nectar.

The Myrmeleontidae, or antlions, have larvae that are almost totally restricted to sand or sandy soils where they live just below the surface and prey on virtually any item that they can grasp in their jaws and subdue. *Myrmeleon* larvae are known for the circular pits that they construct in the sand into which potential prey fall and are captured. Adult antlions are generally predators or omnivores.

The Hanford Site.—Situated in the semi-arid Columbia Plateau Basin of south-central Washington State (Benton Co.), the 1450 km² of the Hanford Nuclear Site were closed to the general public in 1943. Originally acquired by the United States federal government as a site for the production of plutonium to be used in weapons production, the Site is currently administered by the Department of Energy for nuclear waste management, environmental restoration, and research and development.

From an ecological standpoint, the placing of such a large tract of land virtually off limits to public access for over half a century has preserved a shrub-steppe ecosystem that has otherwise changed radically throughout the remainder of the Columbia Plateau. Hanford appears to serve as a refuge for many plants and animals, including insects, that probably were once more common throughout the Plateau but today are confined to small, remnant undisturbed tracts of land.

Physiographically diverse, the Hanford Site consists of a steeply rising, northeast facing slope (Rattlesnake Ridge—1150 m) and extensive flats that slope gently from 500 to 150 m before they reach the Columbia River. Vegetation is primarily a sagebrush-bitterbrush/Sandberg's bluegrass-cheatgrass type; the general habitat is referred to as shrub-steppe (Daubenmire 1970). Several small, permanent springs with associated riparian areas are found in the southeast portion of the Hanford Site; this area is referred to as the Fitzner-Eberhardt Arid Lands Ecology Research Area (ALE).

Climate at Hanford is best characterized as semi-arid with hot and dry summers and cold winters. Precipitation ranges from 30–35 cm at the crest of Rattlesnake Ridge to less than 12 cm in central Hanford and along the Columbia River. Temperatures range from an average of 3° C (36.7° F) in January to 33° C (91.8° F) in July; temperatures of 32° C (90° F) or above occur an average of 56 days per year (ERDA 1975).

In addition to general surveys (ERDA 1975, Rogers 1979), specific groups of insects studied at Hanford include darkling beetles (Rickard et al. 1974, Rickard & Haverfield 1965, Rogers et al. 1978), ground dwelling beetles (Rickard 1970), grasshoppers (Sheldon & Rogers 1978) torymid wasps (Grissell & Zack 1996), weevils (O'Brien & Zack 1979), and shore flies (Zack 1998). The vascular plants

of Hanford are discussed in Sackschewsky et al. (1992). Aspects of flora and fauna are treated in Downs et al. (1993).

This study was undertaken to provide as complete an inventory of the entomofauna of the Hanford Site as reasonably possible given financial, time, and taxonomic resources. The Hanford Site represents one of the largest and least disturbed areas of shrub-steppe habitat in the Pacific Northwest. Although public access to the Site currently is strictly limited because of security and safety concerns, the eventual disposition of these lands, after "clean-up" activities are completed, is now being judged. Individuals making policy decisions on the direction of future land usage are using information generated through studies of the area's biodiversity.

MATERIALS AND METHODS

Snakeflies and non-antlion neuropterans were taken primarily through general collecting activities, principally the sweeping of vegetation. Although antlions were also taken by sweeping or by aerial net, primarily at dusk, most collections were made with light traps using a 150 watt mercury vapor lamp. All insect taxa were sampled through the period 1994–1997. However, more intense studies were conducted during 1996–1997. Through Mar to Nov 1996 we light trapped the extensive sand dunes that border the eastern edge of Hanford along the Columbia River and inland. A single site within the dunes (46°31.369' N 119°21.192' W) was sampled on a weekly to biweekly basis.

During 1997, several xeric sites throughout central Hanford as well as the area adjacent to a permanent alkaline pond (West Lake—46°36.066' N 119°32.788' W) were sampled using a 160 watt mercury vapor lamp. Again, sampling was conducted on a weekly to biweekly basis.

Voucher specimens of all taxa are deposited in the M. T. James Entomological Collection, Washington State University.

RESULTS AND DISCUSSION

Raphidioptera

Raphidiidae

Raphidia bicolor Albarda. The only snakefly encountered at Hanford, adults were taken by sweeping sagebrush and other shrubs. Immatures assumed to be *R. bicolor* were also found on the same shrubs. This is a widespread species found throughout the semi-arid, open shrub habitats of the inland Pacific Northwest and the western United States.

Neuroptera

Chrysopidae

Chrysopa coloradensis Banks. Adults of this Great Basin species were taken throughout the Site from early May through mid-August.

Chrysopa oculata Say. Adults of this transcontinental species were taken throughout the Site from early May through late August.

Chrysoperla plorabunda (Fitch). The most commonly encountered species of green lacewing on the Hanford Site, adults were taken from mid-March through the end of October. This species occurs across North America.

Eremochrysa (Chrysopiella) minora (Banks). A single specimen of this rarely encountered western species was taken on 16 May 1994 while sweeping riparian vegetation along one of Hanford's major spring systems.

Eremochrysa (Eremochrysa) punctinervis MacLachlan. The most commonly encountered species of *Eremochrysa* on the Site, *E. punctinervis* occurs throughout the western United States. It was taken from vegetation in both riparian and open shrub habitats. Specimens were taken from early May through mid-August.

Eremochrysa (Eremochrysa) tibialis Banks. A total of four specimens were taken between mid-July and mid-August while sweeping riparian vegetation along one of the Sites major spring systems. These collections represent a significant range extension for this previously southwestern species.

Coniopterygidae

Coniopteryx sp. Two specimens, taken while sweeping shrub vegetation in mid-April, appear to represent an undescribed species. The only previous Washington record of a coniopterygid is *Conwentzia californica* Meinander (Penny et al. 1997).

Hemerobiidae

Hemerobius humulinus Linnaeus. One specimen of this widespread, Holarctic species (Nakahara 1965, Kevan & Klimaszewski 1987) was taken on 8 Jul 1994 while sweeping riparian vegetation along a small spring situated at approximately 1050 m in elevation.

Hemerobius ovalis Carpenter. Four specimens of this widespread, northwestern United States and western Canada (Nakahara 1965, Kevan & Klimaszewski 1987) species were taken on the Site. Two of them were drawn to a mercury vapor lamp that was placed in an extensive sand dune habitat. Specimens were taken in mid-March as well as late October and early November.

Hemerobius pacificus Banks. This is another widespread species known from western North America (Nakahara 1965, Kevan & Klimaszewski 1987). It was taken in riparian and non-riparian areas from mid-July through late September.

Hemerobius stigma Stephens. A Holarctic species reported from most of the United States and transcontinental in Canada (Kevan & Klimaszewski 1987), it was the most widespread and commonly encountered *Hemerobius* on the Site. Specimens were taken from mid-May through mid-October.

Micromus variolosus Hagen. A widespread species in the western United States and Canada (Carpenter 1940). Specimens were collected in early June and late July.

Sympherobius arizonicus Banks. This primarily is a southwestern species previously known from Arizona and southern California in the United States (Oswald 1988). Two specimens were taken, one in mid-June and the second in late September, from an arid, open shrub area located at approximately 200 m in elevation.

Sympherobius killingtoni Carpenter. This is a widespread species found throughout the western United States but appearing more common in the southwest (Oswald 1988). A single specimen was collected on 18 July while sweeping weedy vegetation along a dirt road located at 400 m elevation.

Sympherobius perparvus (MacLachlan). A widespread western and midwestern species (Oswald 1988) this was the most commonly encountered *Sympherobius* at the Site. It was collected from mid-April through mid-May.

Wesmaelius (Kimminsia) coloradensis (Banks). A single specimen of this western species was taken while sweeping riparian vegetation along a high elevation spring (1050 m) in late July.

Myrmeleontidae

Brachynemurus abdominalis (Say). This is a widespread species in the western United States and was found throughout the Hanford Site. Not only was the species collected at mercury vapor lamps, but it was the only species of antlion that was taken more often by selective netting at dusk when it could be very common. It was also the only species of antlion not collected in the extensive sand dunes bordering the eastern edge of the Hanford Site. It was, however, very common in less sandy soils adjacent to the dunes. *Brachynemurus abdominalis* was taken from mid-June through mid-August.

Brachynemurus blandus (Hagen). This western species was collected only in the extensive sand dunes bordering the Columbia River. All specimens were collected at mercury vapor lamps from late May through mid-June.

Brachynemurus sackeni Hagen. Collected in the sand dunes and in xeric, sandy areas adjacent to the dunes, this early season western species was taken only at mercury vapor lamps and only during the period 19 May through 7 June.

Chaetoleon pusillus (Currie). Collected only in the sand dune habitat and only at mercury vapor lamps. Specimens were taken on 13 Aug and 18 Sep 1996.

Clathroneuria schwarzi (Currie). This western United States species was collected only once on 20 Jul 1995 while sweeping weedy vegetation along a dirt road located at 400 m in elevation in a sagebrush/bunchgrass area.

Myrmeleon exitalis Walker. This species is widespread in the western United States. It was collected on the sand dunes as well as at other locations; a single specimen was taken on 5 Aug 1994 while sweeping riparian vegetation. The majority of specimens were collected at mercury vapor lamps, especially on the dunes, from mid-September through mid-October.

Paranthaclis congener (Hagen). This large, western species was one of the more commonly encountered antlions and was collected at several locations throughout the Site. It was especially abundant on the sand dunes where it was attracted to mercury vapor lamps. *Paranthaclis congener* was taken consistently from late June through mid-August.

Psammoleon sinuatus Currie. Only two specimens of this species were collected on 12 Jul 1995 at a mercury vapor lamp adjacent to a small spring system located at 500 m in elevation. This is the first collection of *P. sinuatus* north of Utah.

Scotoleon nigrilabris (Hagen). This species is widespread in the western United States. It was one of the more common of the antlions taken, especially at, but not limited to the sand dunes. It was collected at several locations on the xeric, shrub flats in the northeastern portion of the Site. Specimens were consistently taken at mercury vapor lamps from mid-August through late September.

Scotoleon peregrinus (Hagen). As was its congener, this was one of the more consistently and abundantly taken species, especially on the sand dunes. This is surprising since it was not previously known to occur within 500 km of Washington. Although there is temporal overlap between *S. nigrilabris* and *S. peregrinus*, the latter is much more abundant at the lights from mid-July through mid-August. However, occasional specimens of *S. peregrinus* were taken between mid-

June and early October. In contrast, *S. nigrilabris* was collected only between 28 Aug and 18 Sep during 1996 and 1997.

DISCUSSION

The 26 species collected in this survey include five that are transcontinental or Holarctic and 17 that are typical of arid to semi-arid regions in the western United States. Three members of the latter group had not previously been recorded from Washington. They are: *C. schwarzi*, *B. sackeni*, and *S. nigrilabris*. The *Coniopteryx* sp. will also constitute a new state record when it is identified because *C. californica* is the only coniopterygid currently reported from Washington (Penny et al. 1997).

More surprising was the discovery of four species previously known only from the southwestern United States. These species are: *E. tibialis*, *S. arizonicus*, *P. sinuatus*, and *S. peregrinus*. None of these was known north of Nevada or west of Wyoming. Thus, these collections represent range extensions of approximately 500–1100 km for these species.

That a survey of one area could add seven new state records and four major range extensions reaffirms the view that the neuropteroid fauna of the northwestern United States remains poorly known. The delicate nature of neuropteroid specimens and an historic lack of identification keys that include all currently recognized taxa have contributed to this situation. However, taxonomic progress is being made. Thus, we anticipate the total of 58 neuropteroid species now known to occur in Washington will be further increased.

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